Claims

What is claimed is:

1. A FLADE counter-rotating fan aircraft gas turbine engine comprising axially spaced-apart first and second counter-rotatable fans and at least one row of FLADE fan blades disposed radially outwardly of and drivingly connected to one of the first and second counter-rotatable fans.

2. An engine as claimed in claim 1 further comprising a second low pressure turbine drivingly connected to the first counter-rotatable fan and a first low pressure turbine drivingly connected to the second counter-rotatable fan.

3. An engine as claimed in claim 1 further comprising:

a core engine located downstream and axially aft of the first and second counter-rotatable fans,

a fan bypass duct located downstream and axially aft of the first and second counter-rotatable fans and circumscribing the core engine, and

the row of FLADE fan blades radially extend across a FLADE duct circumscribing the first and second counter-rotatable fans and the fan bypass duct.

4. An engine as claimed in claim 3 further comprising the row of FLADE fan blades disposed between an axially forward row of variable first FLADE vanes and an axially aft row of second FLADE vanes in the FLADE duct.

5. An engine as claimed in claim 3 further comprising a first low pressure turbine drivingly connected to the second counter-rotatable fan and a second low pressure turbine drivingly connected to the first counter-rotatable fan.

6. An engine as claimed in claim 2 further comprising:

the core engine having in serial flow relationship a row of core driven fan stator vanes, a core driven fan with at least one row of core driven fan blades, a high pressure compressor, a combustor, and a high pressure turbine drivingly connected to the core driven fan,

first and second counter-rotatable fans are radially disposed across an annular first fan duct,

the core driven fan is radially disposed across an annular second fan duct,

a vane shroud dividing the core driven fan stator vanes into radially inner and outer vane hub and tip sections,

a fan shroud dividing the core driven fan blades into radially inner and outer blade hub and tip sections,

a first bypass inlet to the fan bypass duct is disposed axially between the second counter-rotatable fan and the annular core engine inlet to the core engine,

a fan tip duct across the vane tip sections of the core driven fan stator vanes and across the blade tip sections of the core driven fan blades extending to a second bypass inlet to the fan bypass duct, and

a first varying means for independently varying a flow area of the vane tip section.

7. An engine as claimed in claim 6 further a second varying means for independently varying a flow area of the vane hub section.

8. An engine as claimed in claim 7 wherein the first and second varying means include independently varying vane tip sections and independently varying vane hub sections respectively.

9. An engine as claimed in claim 8 further comprising a front variable area bypass injector door in the first bypass inlet.

10. An engine as claimed in claim 9 further comprising the first and second varying means including:

an inner shaft attached to a pivotable trailing edge hub flap of the vane hub section,

an outer shaft attached to a pivotable trailing edge tip flap of the vane tip section,

the inner shaft coaxially disposed within an outer shaft of the fan stator vane,

a first unison ring connected in actuating relationship to a first lever arm which is connected in rotatably actuating relationship to the inner shaft, and

a second unison ring connected in actuating relationship to a second lever arm which is connected in rotatably actuating relationship to the outer shaft.

11. An engine as claimed in claim 6 further comprising:

the row of FLADE fan blades disposed radially outwardly of and drivingly connected to the second

counter-rotatable fan,

the high pressure turbine having a row of high pressure turbine nozzle stator vanes axially located between the combustor and a row of high pressure turbine blades of the high pressure turbine,

the row of high pressure turbine blades being counter-rotatable to the first low pressure turbine,

a row of variable low pressure stator vanes between first and second rows of low pressure turbine blades of the first and second low pressure turbines respectively, and

the row of high pressure turbine nozzle stator vanes, the row of high pressure turbine blades, the first row of low pressure turbine blades, the row of variable low pressure stator vanes, and the second row of low pressure turbine blades being in serial axial and downstream relationship.

12. An engine as claimed in claim 11 further a second varying means for independently varying a flow area of the vane hub section.

13. An engine as claimed in claim 12 wherein the first and second varying means include independently varying vane tip sections and independently varying vane hub sections respectively.

14. An engine as claimed in claim 13 further comprising a front variable area bypass injector door in the first bypass inlet.

15. An engine as claimed in claim 14 further comprising the first and second varying means including:

an inner shaft attached to a pivotable trailing

edge hub flap of the vane hub section,

an outer shaft attached to a pivotable trailing edge tip flap of the vane tip section,

the inner shaft coaxially disposed within an outer shaft of the fan stator vane,

a first unison ring connected in actuating relationship to a first lever arm which is connected in rotatably actuating relationship to the inner shaft, and

a second unison ring connected in actuating relationship to a second lever arm which is connected in rotatably actuating relationship to the outer shaft.

16. An engine as claimed in claim 6 further comprising:

a plurality of circumferentially disposed hollow struts in fluid flow communication with the FLADE duct,

a substantially hollow centerbody supported by and in fluid flow communication with the hollow struts, and

a variable area flade air nozzle including an axially translatable plug within the hollow centerbody and a radially outwardly positioned fixed nozzle cowling of the centerbody.

17. An engine as claimed in claim 16 further comprising:

the row of FLADE fan blades disposed radially outwardly of and drivingly connected to the second counter-rotatable fan,

the high pressure turbine having a row of high pressure turbine nozzle stator vanes axially located between the combustor and a row of high pressure

turbine blades of the high pressure turbine,

the row of high pressure turbine blades being counter-rotatable to the first low pressure turbine, and

a row of variable low pressure stator vanes between first and second rows of low pressure turbine blades of the first and second low pressure turbines respectively,

the row of high pressure turbine nozzle stator vanes, the row of high pressure turbine blades, the first row of low pressure turbine blades, the row of variable low pressure stator vanes, and the second row of low pressure turbine blades being in serial axial and downstream relationship.

18. An engine as claimed in claim 17 further comprising a variable throat area engine nozzle downstream and axially aft of the counter-rotatable second low pressure turbine and the fan bypass duct.

19. An engine as claimed in claim 18 further comprising the variable throat area engine nozzle including an axially translatable radially outer annular convergent and divergent wall and a radially fixed and axially translatable annular inner wall on the centerbody.

20. An engine as claimed in claim 19 further comprising

the variable throat area engine nozzle having an axially translatable radially outer annular convergent/divergent wall spaced radially outwardly apart from a radially fixed and axially translatable annular inner wall on the centerbody,

the translatable radially outer annular

convergent/divergent wall operable to control a throat area between the convergent/divergent wall and the radially fixed and axially translatable annular inner wall, and

the translatable radially outer annular convergent/divergent wall operable to control a nozzle exit area of the engine nozzle.

21. An engine as claimed in claim 11 wherein the row of low pressure stator vanes are variable.

22. An engine as claimed in claim 11 wherein the row of low pressure stator vanes are fixed.

23. An engine as claimed in claim 6 further comprising:

the high pressure turbine having a row of high pressure turbine nozzle stator vanes axially located between the combustor and a row of high pressure turbine blades of the high pressure turbine,

the row of high pressure turbine blades being counter-rotatable to the first low pressure turbine, and

a row of fixed stator vanes between the row of high pressure turbine blades and the first low pressure turbine,

no vanes between the first and second rows of low pressure turbine blades of the first and second low pressure turbines respectively, and

the row of high pressure turbine nozzle stator vanes, the row of high pressure turbine blades, the row of fixed stator vanes, the first row of low pressure turbine blades, and the second row of low pressure turbine blades being in serial axial and downstream relationship.

24. An engine as claimed in claim 23 further a second varying means for independently varying a flow area of the vane hub section.

25. An engine as claimed in claim 24 wherein the first and second varying means include independently varying vane tip sections and independently varying vane hub sections respectively.

26. An engine as claimed in claim 25 further comprising a front variable area bypass injector door in the first bypass inlet.

27. An engine as claimed in claim 6 further comprising:

the second counter-rotatable fan having axially spaced apart rows of first and second stage blades and a row of second stage fan vanes therebetween,

the row of FLADE fan blades disposed radially outwardly of and drivingly connected to the row of second stage blades,

the high pressure turbine having a row of high pressure turbine nozzle stator vanes axially located between the combustor and a row of high pressure turbine blades of the high pressure turbine,

the row of high pressure turbine blades being counter-rotatable to the first low pressure turbine,

a row of fixed stator vanes between the row of high pressure turbine blades and the first low pressure turbine,

no vanes between the first and second rows of low pressure turbine blades of the first and second low pressure turbines respectively, and

the row of high pressure turbine nozzle stator

vanes, the row of high pressure turbine blades, the row of fixed stator vanes, the first row of low pressure turbine blades, and the second row of low pressure turbine blades being in serial axial and downstream relationship.

28. An engine as claimed in claim 27 further a second varying means for independently varying a flow area of the vane hub section.

29. An engine as claimed in claim 28 wherein the first and second varying means include independently varying vane tip sections and independently varying vane hub sections respectively.

30. An engine as claimed in claim 29 further comprising a front variable area bypass injector door in the first bypass inlet.

31. An engine as claimed in claim 30 further comprising the first and second varying means including:

an inner shaft attached to a pivotable trailing edge hub flap of the vane hub section,

an outer shaft attached to a pivotable trailing edge tip flap of the vane tip section,

the inner shaft coaxially disposed within an outer shaft of the fan stator vane,

a first unison ring connected in actuating relationship to a first lever arm which is connected to rotatably actuating relationship to the inner shaft, and

a second unison ring connected in actuating relationship to a second lever arm which is connected in rotatably actuating relationship to the outer

shaft.

32. An engine as claimed in claim 6 further comprising:

the second counter-rotatable fan having axially spaced apart rows of first and second stage blades and a row of second stage fan vanes therebetween,

the row of FLADE fan blades disposed radially outwardly of and drivingly connected to the row of second stage blades,

the high pressure turbine having a row of high pressure turbine nozzle stator vanes axially located between the combustor and a row of high pressure turbine blades of the high pressure turbine,

the row of high pressure turbine blades being counter-rotatable to the first low pressure turbine,

a row of variable low pressure stator vanes between first and second rows of low pressure turbine blades of the first and second low pressure turbines respectively, and

the row of high pressure turbine nozzle stator vanes, the row of high pressure turbine blades, the first row of low pressure turbine blades, the row of variable low pressure stator vanes, and the second row of low pressure turbine blades being in serial axial and downstream relationship.

33. An engine as claimed in claim 32 further a second varying means for independently varying a flow area of the vane hub section.

34. An engine as claimed in claim 33 wherein the first and second varying means include independently varying vane tip sections and independently varying vane hub sections respectively.

35. An engine as claimed in claim 34 further comprising a front variable area bypass injector door in the first bypass inlet.

36. An engine as claimed in claim 35 further comprising the first and second varying means including:

an inner shaft attached to a pivotable trailing edge hub flap of the vane hub section,

an outer shaft attached to a pivotable trailing edge tip flap of the vane tip section,

the inner shaft coaxially disposed within an outer shaft of the fan stator vane,

a first unison ring connected in actuating relationship to a first lever arm which is connected in rotatably actuating relationship to the inner shaft, and

a second unison ring connected in actuating relationship to a second lever arm which is connected in rotatably actuating relationship to the outer shaft.

37. An engine as claimed in claim 6 further comprising:

a plurality of circumferentially disposed hollow struts in fluid flow communication with the FLADE duct,

a substantially hollow centerbody supported by and in fluid flow communication with the hollow struts,

a variable area flade air nozzle including an axially translatable plug within the hollow centerbody and a radially outwardly positioned fixed nozzle cowling of the centerbody,

a variable throat area engine nozzle downstream and axially aft of the counter-rotatable second low pressure turbine and the fan bypass duct,

the second counter-rotatable fan having axially spaced apart rows of first and second stage blades and a row of second stage fan vanes therebetween, and

the row of FLADE fan blades disposed radially outwardly of and drivingly connected to the row of second stage blades.

38. An engine as claimed in claim 37 further comprising:

the high pressure turbine having a row of high pressure turbine nozzle stator vanes axially located between the combustor and a row of high pressure turbine blades of the high pressure turbine,

the row of high pressure turbine blades being counter-rotatable to the first low pressure turbine,

a row of fixed stator vanes between the row of high pressure turbine blades and the first low pressure turbine,

no vanes between the first and second rows of low pressure turbine blades of the first and second low pressure turbines respectively, and

the row of high pressure turbine nozzle stator vanes, the row of high pressure turbine blades, the row of fixed stator vanes, the first row of low pressure turbine blades, and the second row of low pressure turbine blades being in serial axial and downstream relationship.

39. An engine as claimed in claim 38 further a second varying means for independently varying a flow area of the vane hub section.

40. An engine as claimed in claim 39 wherein the first and second varying means include independently varying vane tip sections and independently varying vane hub sections respectively.

41. An engine as claimed in claim 40 further comprising a front variable area bypass injector door in the first bypass inlet.

42. An engine as claimed in claim 41 further comprising the first and second varying means including:

an inner shaft attached to a pivotable trailing edge hub flap of the vane hub section,

an outer shaft attached to a pivotable trailing edge tip flap of the vane tip section,

the inner shaft coaxially disposed within an outer shaft of the fan stator vane,

a first unison ring connected in actuating relationship to a first lever arm which is connected in rotatably actuating relationship to the inner shaft, and

a second unison ring connected in actuating relationship to a second lever arm which is connected in rotatably actuating relationship to the outer shaft.

43. An engine as claimed in claim 37 further comprising:

the high pressure turbine having a row of high pressure turbine nozzle stator vanes axially located between the combustor and a row of high pressure turbine blades of the high pressure turbine,

the row of high pressure turbine blades being counter-rotatable to the first low pressure turbine,

a row of variable low pressure stator vanes between first and second rows of low pressure turbine blades of the first and second low pressure turbines respectively, and

the row of high pressure turbine nozzle stator vanes, the row of high pressure turbine blades, the first row of low pressure turbine blades, the row of variable low pressure stator vanes, and the second row of low pressure turbine blades being in serial axial and downstream relationship.

44. An engine as claimed in claim 43 further a second varying means for independently varying a flow area of the vane hub section.

45. An engine as claimed in claim 44 wherein the first and second varying means include independently varying vane tip sections and independently varying vane hub sections respectively.

46. An engine as claimed in claim 45 further comprising a front variable area bypass injector door in the first bypass inlet.

47. An engine as claimed in claim 46 further comprising the first and second varying means including:

an inner shaft attached to a pivotable trailing edge hub flap of the vane hub section,

an outer shaft attached to a pivotable trailing edge tip flap of the vane tip section,

the inner shaft coaxially disposed within an outer shaft of the fan stator vane,

a first unison ring connected in actuating relationship to a first lever arm which is connected

in rotatably actuating relationship to the inner shaft, and

a second unison ring connected in actuating relationship to a second lever arm which is connected in rotatably actuating relationship to the outer shaft.

48. An engine as claimed in claim 37 further comprising the variable throat area engine nozzle including an axially translatable radially outer annular convergent and divergent wall and a radially fixed and axially translatable annular inner wall on the centerbody.

49. An engine as claimed in claim 48 further comprising

the variable throat area engine nozzle having an axially translatable radially outer annular convergent/divergent wall spaced radially outwardly apart from a radially fixed and axially translatable annular inner wall on the centerbody,

the translatable radially outer annular convergent/divergent wall operable to control a throat area between the convergent/divergent wall and the radially fixed and axially translatable annular inner wall, and

the translatable radially outer annular convergent/divergent wall operable to control a nozzle exit area of the engine nozzle.